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Peach Yellows Report

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W. A. McCubbin
Bureau of Plant Industry

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PEACH YELLOWS REPORT

W. A. McCubbin
Bureau of Plant Industry

I. PEACH YELLOWS INSPECTION IN 1927

The season of 1927 was almost normal as far as peach yellows inspection was concerned. The weather was generally cool and moist, and some time was lost on account of wet days. The fruit was sufficient in amount, in most counties, to be relied upon as a means of determining early stages of yellows. Some second growth with yellowish smaller shoots occurred toward the end of the season, but our inspectors have learned to distinguish this from true cases of yellows. The extensive use of PDB. has made yellows inspection very much easier since there are now fewer trees injured by borers so that they are difficult to inspect properly. During 1927 a complete reinspection could not be made of all orchards, but all doubtful cases, and orchards which were gone over early in the season, were given a second inspection.

The organization of yellows was along the lines used in previous years. Two new men were added to the staff, Mr. S. C. Miller and Mr. J. F. Rees. In addition to the usual trip which the whole staff makes together at the beginning of the season, these two men were placed alternately with Mr. Peirce and Mr. Holdridge for a week, in order to gain experience, after which they went to their allotted territory to work alone. The staff was also increased this season by the presence of Dr. Albert Hartzell, of the Boyce Thompson Institute, who acted as inspector from July 15 to August 15 largely with the object of getting close contact with peach yellows in the field for research purposes. The men engaged in inspection and the areas covered by them are as follows: F. L. Holdridge—Lancaster; E. F. Peirce—York, Adams and Chester; A. W. Buckman—Bucks, Montgomery and Lehigh; F. G. Wilson—Dauphin, East Cumberland, and part of York; S. C. Miller—Franklin; J. F. Rees—Berks; Hartzell—Lebanon.

A statistical record of the results of this season's inspection is given in tables and graphs on appended sheets. In general inspection was extended into 13 counties covering the southeastern portion of the state. Four hundred and forty-seven orchards, containing 802,933 trees, were covered, and of these 1,846 trees were marked for yellows or little peach. The percentage of yellows found this season throughout the whole inspection amounts to 0.23. This is by far the lowest figure yet attained. The accompanying table and graphs appended indicate the drop in yellows in the course of this inspection work since 1920 when the work was started. Another table and graph indicate the results of the inspection in trees of various ages. From this data it is clear that the disease appears in appreciable amounts only after the orchard is 4 to 5 years old.

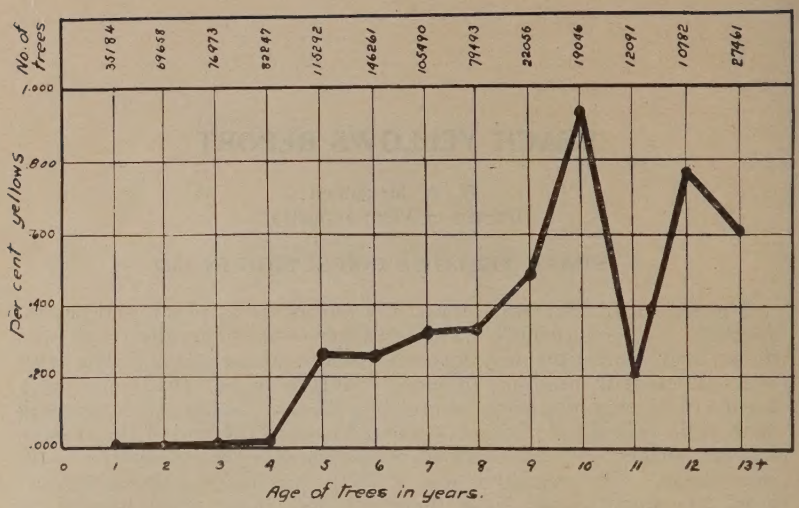

Fig. 1. Number of trees and percentage of Yellows in trees of different ages as found in the 1927 inspection.

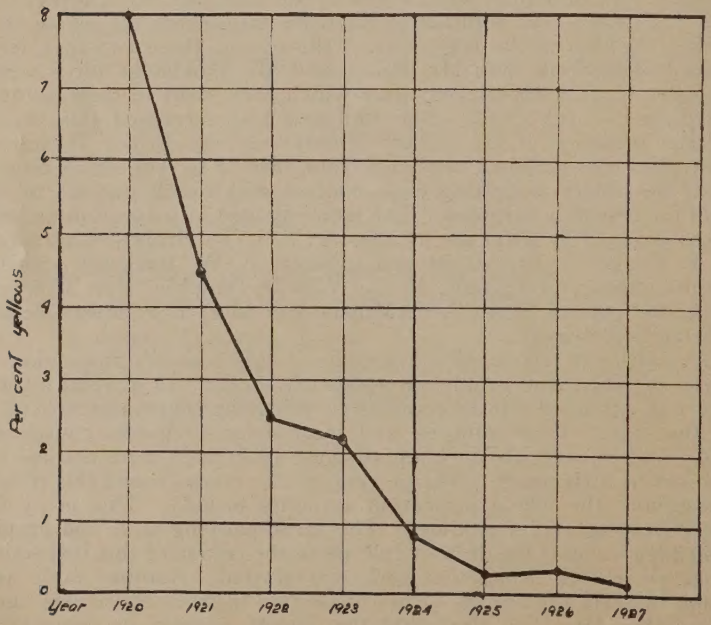

Fig. 2. Percentage of Yellows in Pennsylvania peach orchards covered by inspection in the years 1926-1927.

Considerable data was accumulated during the season on points suspected to have a bearing on the question of spread. A report on this phase of the yellows work is appended.

During the coming season it is proposed to omit inspection in a number of orchards where the owners are already willing and able to look after their own interests. The time thus saved will be devoted to extending inspection into other peach areas in the state which have not yet been reached owing to lack of time and men. Where orchards are thus omitted from the usual survey it is not intended to neglect them entirely since it is still desired to continue to record detailed information regarding the number of trees removed for yellows each year. The mass of data that is now available since this inspection began promises to be of considerable value in future investigations of the peach yellows disease.

Table 1. Peach Yellows Inspection Results in 1927 in Pennsylvania Arranged by Counties

County	Orchards Inspected	Trees Inspected	Trees Marked	Per Cent Yellows
Adams	61	78,472	140	.178
Berks	54	147,397	329	.223
Bucks	44	41,253	120	.290
Cumberland	33	51,343	167	.325
Chester	33	25,052	57	.227
Dauphin	26	26,790	74	.276
Delaware	14	10,067	31	.307
Franklin	69	238,310	467	.195
Lancaster	27	37,845	100	.264
Lebanon	14	25,965	145	.558
Lehigh	9	31,950	41	.123
Montgomery	23	35,169	61	.173
York	40	52,420	114	.217
13 Counties	447	802,033	1,846	.230

Table 2. Peach Yellows Inspection Records in 1927 in Pennsylvania showing Amount of Disease in Trees of Various Ages

Age of Orchard in Years	No. of Trees	Trees Marked	Per Cent Yellows
1	35,184	0	.000
2	69,658	2	.002
3	76,973	8	.010
4	82,247	14	.017
5	115,292	309	.268
6	146,261	353	.241
7	105,490	344	.326
8	79,493	258	.324
9	22,055	108	.489
10	19,046	179	.939
11	12,091	24	.198
12	10,782	82	.760
13 and over	27,461	165	.601
Total, 1927	802,033	1,846	.230

II. EIGHT YEARS OF YELLOWS INSPECTION IN PENNSYLVANIA

Yellows Inspection Organized

The present system of peach yellows was planned in 1920. From that time to the present it has been a yearly activity and after eight years of operation it seems fitting to summarize the whole situation partly to obtain a composite picture of the entire project and partly to establish viewpoints which may be of value in future work.

When methodical inspection was planned in 1920 it was not possible to begin on an extensive scale. The most that could be done in that year was to ascertain in as many cases as possible in a preliminary way the extent of the disease and the attitude of the growers toward a yearly system of inspection.

The result of the survey indicated a great many orchards badly polluted with yellows, but it also showed that where the owners were promptly removing diseased trees yellows was being held in check. The average amount of disease for the orchards covered in 1920 was 8 to 12 per cent. The data obtained did not permit the exactness of statement attained in subsequent work and for this reason the lower figure of 8 per cent is taken as safely representing the general situation at the beginning of this project.

The attitude of the growers toward the proposed inspection varied. It was welcomed as a real service by some; on the other hand a few were distinctly hostile to the idea; the majority of the growers however were neither eager for inspection nor opposed to it—they were simply indifferent.

The considerable losses from yellows and the cases where successful control had been obtained by prompt removal encouraged the Department to continue the work in 1921, and when the general amount of yellows appeared to lessen appreciably in that year and 1922 the value of the project was accepted, and the policy of a yearly inspection was established.

Support by Pennsylvania Horticultural Association

In the initial stages of yellows inspection a large share of credit is due the Pennsylvania Horticultural Association which from the first gave its support to the plan and for several years appointed a Peach Yellows Committee to work with the Department on the project. In the first few years of work the inspection was carried on with no special budgetary allotment and as an incidental activity. When it became established as a useful activity proper budgetary support was accorded.

Inspection Policy

The policy laid down at the beginning was to keep this work on a service and educational basis rather than to regard it as a purely regulatory matter. It is true that all the inspection has been carried out under authority of the Horticultural Inspection Act and its successor the Plant Pest Act. But the disease had long

been widely spread and the orchards for the most part were far enough separated to minimize orchard-to-orchard spread except in a very few instances.

Because of these features the dangerous nature of the disease was considered as largely the concern of the growers individually rather than of the community at large. Under our conditions this policy could be adopted with comparative safety although it is clearly recognized that under other conditions or for other types of disease such a policy might not be feasible. The essential correctness of this policy has been amply justified by the outcome. During the eight years of inspection **there has not been a single case of prosecution.** And yet the inspection system, as shown by the accompanying figures and charts, has succeeded in reducing the disease to an almost negligible average of 0.23 per cent. Furthermore the attitude of the peach growers has shown throughout a steadily mounting interest and confidence in the inspection service, and an increasing tendency to remove their own trees promptly without waiting for the visit of the inspector. It is very certain that if a policy of a peremptory nature had been followed throughout, this friendly and self-reliant attitude would never have been developed.

Policy in Marking Trees

Another feature of the general policy which has had a great bearing on inspection success is the iron-clad rule among the inspectors that no tree shall be marked on which there is not unmistakeable evidence of the disease. In some respects the symptoms of Yellows blend into those of other troubles so that without this rule there would be at times a tendency to mark trees suffering merely from other ailments. But where any doubt exists the inspector does not mark. This point in policy has come in for severe criticism at times on the ground that certain diseased trees will be allowed to remain because of the lack of definite symptoms. This is quite possible, but the force of such criticism is greatly weakened when one looks at the tables showing the year-by-year diminution of the disease. In the face of these results the trees missed by following this rule cannot have had any weighty importance. On the other hand adherence to this strict policy in marking trees has gone far to establish confidence among the peach growers. It can readily be supposed that not once but many times over in these years trees marked by our inspectors have been allowed to remain because the grower questioned the diagnosis. Several of these cases have come to our notice through the admission that next year the tree showed symptoms which the grower accepted. No doubt the rest had a similar ending or we would have quickly heard of them. At any rate this policy has been an all-important factor in obtaining the confidence of the peach owner and inducing him to use the axe without question or delay.

The method of marking trees is worthy of mention here. Suggestions of various kinds were made at the beginning involving chalk marks, broken limbs, string, etc. The method finally adopted and in use to date is to blaze one side of the trunk or main limbs with an axe. This method is simple and rapid, and the blaze is a lasting and non-removable mark. This type of mark also has a psychologi-

cal significance. Injury of the type of a good-sized blaze made on an orchard tree in good health would naturally excite anger and resentment in the owner. For this reason the same blaze on a diseased tree conveys clearly the idea of worthlessness since no one would thus desecrate a normal tree.

Yellows Records

In the matter of records care has been taken in the last six years to keep an orderly file of cards giving all the data that would likely be of future use, and the number on these cards correspond with location numbers on county maps so that any inspector can take over any area with a minimum of trouble.

Yellows Inspection Staff

The Department has also been fortunate in the personnel of the inspection staff; especially in the early years the success of the work was in a large measure due to the judgment, experience and energy of F. L. Holdridge, E. F. Peirce, A. O. Finn and A. W. Buckman. As the work expanded the plan was adopted of engaging teachers for the period of their summer vacation and as these temporary inspectors come back year after year the Department is provided with an efficient force of temporary inspectors already trained and experienced, and thus escapes the necessity of carrying men over the winter period or else training a new and untried force each season.

Who Pays for Yellows Inspection

As mentioned elsewhere the Pennsylvania Department of Agriculture carried the yellows inspection service as an incidental project at first. When it assumed the form of a permanent service the question of financial support arose. There is a generally accepted principle in work of this kind that the cost of a service should fall where the benefit is bestowed. On this basis it seemed fair that the orchards' owners should be called upon to pay at least the major portion of the cost. Although this was accepted in principle yet there loomed up such difficulties in apportioning the cost and collecting the money that no final steps toward putting this program into effect have been taken to date. The cost of inspection is relatively so small that a great part of the revenue would be taken up in cost of collection.

Inspection Difficulties

Peach tree borer. In the first years of inspection the general borer situation was bad. It is true that most growers made an effort to "worm" their trees systematically but a great many borers were missed even under the best conditions. Numerous trees in these orchards and in others in which treatment had been neglected, suffered to such an extent from borer injury that yellows inspection became a matter of painstaking care. In the later years of this period the use of PDB has been almost universally adopted with such success that inspection difficulties arising from borer injury have been materially reduced.

Growth irregularities. In several seasons second growth of twigs has followed after a continued dry period in summer. The presence of these new lighter colored shoots at the time of inspection has added to the inspector's work. It is not so much that he mistakes them for yellows symptoms as that their numbers confuse other true yellows symptoms and thus make detection of the disease more difficult.

Root troubles. In the course of this inspection two obscure troubles have been observed on peach trees. One of these is oedema or more popularly "punky root" and the other is a rootlet rot. Their foliage symptoms are not readily confused with yellows, but they had to be sorted out as distinct individual maladies before they could be eliminated from the yellows problem.

Little peach. Little mention has been made of this disease in this or other reports. Two reasons may be mentioned for this omission:—the comparatively few cases of little peach encountered in the inspection areas, and the fact that it is convenient to consider both little peach and yellows together for record purposes.

The little peach disease has been observed only five or six times in the counties covered and while it is considered even more damaging than yellows its small occurrence in point of numbers makes it hardly worth while to segregate it in the inspection program, especially as in the end treatment for both diseases is the same.

Lack of fruit. In several of the years in this period frost in spring killed the bloom to such an extent that little fruit developed. In these seasons the very reliable symptom of premature ripening was lacking.

Interplanted peaches. A great many peach orchards, perhaps the majority, have been interplanted in apples and will be removed entirely when the apple trees reach the crowding stage. In such cases there is usually a laxity of quite understandable nature toward removal of yellows trees when the natural term of the orchard is approaching. No attempt is made to urge yellows removal in these circumstances except where a nearby young orchard is endangered.

Second inspection. At the outset it was hoped to be able to give all the orchards covered, two inspections during the summer. It has not been possible to make this complete re-inspection in any year nor in the light of the present situation does it seem necessary. In each county however the aim is to provide a second inspection for the orchards covered in the early part of the inspection period (July 1-15) and also for all orchards where there were doubtful or suspicious cases that could not be fully settled earlier in the season.

Table 3. Summary of Peach Yellows Inspection Records in Pennsylvania Covering the Years 1921-1927

Year	No. of Trees	Trees Marked	Per Cent Yellows
1921	287,466	17,376	4.45
1922	442,507	11,052	2.50
1923	482,614	10,698	2.21
1924	674,012	6,046	.89
1925	655,493	2,326	.35
1926	624,743	2,524	.40
1927	802,033	1,846	.23
Total, 7 years	3,968,868	51,868	1.30

Table 4. Percentage of Yellows in Trees of Different Ages: 1922-1927

Ages of Trees (Years)	1922		1923		1924		1925		1926		1927	
	No. Trees Inspected	Per Cent Yellows	No. Trees Inspected	Per Cent Yellows	No. Trees Inspected	Per Cent Yellows	No. Trees Inspected	Per Cent Yellows	No. Trees Inspected	Per Cent Yellows	No. Trees Inspected	Per Cent Yellows
1	11,680	.000	20,204	.000	9,268	.000	28,965	.000	16,490	.000	35,184	.000
2	5,200	.000	44,454	.380	68,667	.007	37,941	.007	40,142	.002	69,658	.002
3	6,980	.650	75,073	.670	104,884	.180	79,142	.027	42,293	.030	76,973	.010
4	3,982	.950	39,288	1.620	155,506	.400	130,303	.146	91,872	.300	82,247	.017
5	10,825	1.690	24,207	3.600	70,169	.740	145,101	,232	123,343	.300	115,292	.268
6	8,700	2.050	30,815	4.610	41,234	.930	62,100	.380	103,322	.440	146,261	.241
7	14,941	3.300	24,661	3.740	34,738	1.730	28,866	.670	83,959	.450	105,490	.326
8	19,994	4.560	25,104	4.960	25,829	3,090	26,333	.790	23,951	.710	79,493	.324
9	12,565	6.720	130,510*	2.670	19,297	3.550	23,417	1,150	21,099	.800	22,055	.489
10	14,836	1.730	----------	----------	16,493	1.740	20,199	1.130	17,754	1.000	19,046	.939
11	6,565	7.060	----------	----------	15,359	3.300	17,317	1.430	14,387	1.260	12,091	.198
12	15,300	3.410	----------	----------	22,416	2.120	9,538	.510	15,679	1,020	10,782	.760
13**	400	23.000	----------	----------	90,152	1.080	46,271	.700	30,452	.500	27,461	.601
14	4,325	13.640	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

*This figure includes trees of 9 years and older.
**This figure includes trees 13 years old and older, except for the year 1922.

Graphs Showing the Percentage of Yellows in Trees of Different Ages in the years 1922-1927 inclusive

(Vertical figures show per cent of yellows, horizontal figures show age of trees)

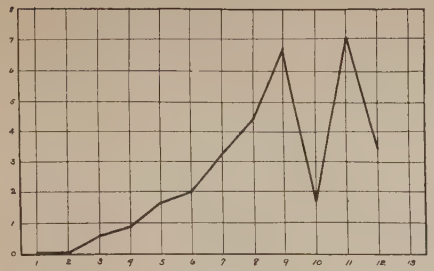

Fig. 3. 1922

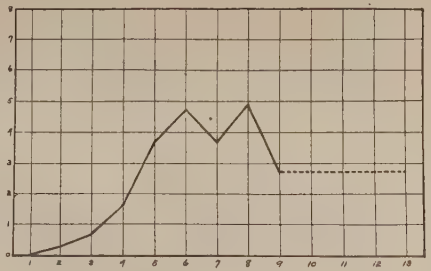

Fig. 4. 1923

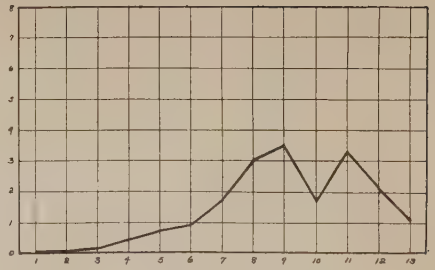

Fig. 5. 1924

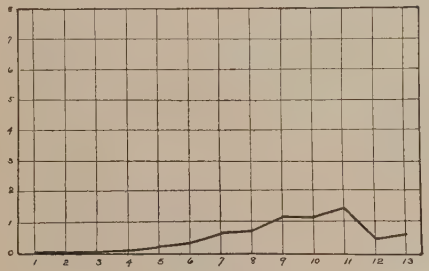

Fig. 6. 1925

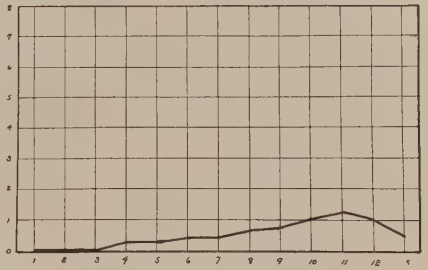

Fig. 7. 1926

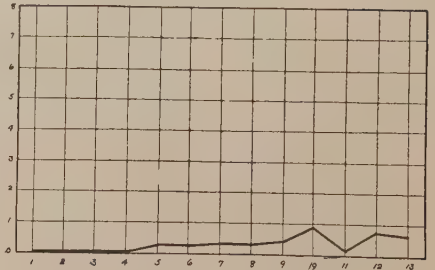

Fig. 8. 1927

III. FIELD OBSERVATIONS ON PEACH YELLOWS

During the course of peach yellows inspection in Pennsylvania in the years 1920-27 the writer has had favorable opportunity to observe this disease under a wide variety of conditions. In addition to taking part, when necessary, in actual inspection, he has throughout these years been called upon many times each season to diagnose puzzling cases for the regular inspection staff; and on many occasions peculiar and outstanding cases of the disease have been reported by interested and observant members of the inspection service for his further observation.

From the mass of material thus passing under observation there have gradually emerged certain field relationships which, after further study are judged to be worthy of record. Although these observations do not permit of any definite conclusion, they are recorded in the hope that they may be of value in further studies of the yellows problem.

Concentration of Yellows in Certain Locations

It has long been observed that the yellows disease is likely to be found in groups, and frequently in such cases there is evidence which indicates that spread has taken place from some one or two trees originally diseased to those in the immediate neighborhood. The spread in such cases is rarely mathematically perfect; trees adjacent to the obviously more advanced case may escape infection, while those farther out are attacked. On the whole, however, such groupings do present the aspect of a circular spread, and if we accept the situation at its face value then the spread from one tree to another nearby is a reasonable conclusion. It is further evident from such cases that pruning, picking, thining and similar cultural operations could hardly be considered factors in spread of this type; the tendency of such operations would be to spread the disease in orderly fashion along the rows rather than in a circular manner.

Infection spots of the type just mentioned may occur in any part of an orchard and are more evident after the orchard reaches the age of six or seven years. There is another type of Yellows "nest" however which seems to hint that the disease has some relationship other than the peach-to-peach spread noted above. In these cases a development of yellows occurs early in the life of the orchard in groups of several to many trees adjacent to some area well supplied with a varied natural and permanent vegetation. At the time this early development occurs the remainder of the orchard may be and usually is free from yellows. While there is a possibility that some of the diseased trees in such groups may have been infected from those near at hand this does not seem probable on account of the early and simultaneous appearance of the disease in such numbers. Even allowing for a certain amount of secondary infection one is still confronted with the question of why the original infections took place in such cases.

In order to illustrate this peculiarity of yellows incidence six typical cases are here outlined. In each instance a chart of a small portion of the orchard where the yellows group occurs is given and

its relation to the adjacent wild vegetation is indicated. There are also given other data on these cases including a list of the wild plants growing in the adjacent area as well as among the diseased groups of trees. To save space the plant lists for all cases are combined in one tabular statement. Dr. E. M. Gress, Botanist of this Department, has been kind enough to help in the identification of many of the doubtful species.

Case I

In the orchard of Herbert Allison near Shippensburg in Cumberland County, there was noted in 1925 by F. G. Wilson inspector for that district, a typical case of yellows grouping (See Fig. 9). This orchard was charted and a list of plants made October 16, 1926 at which time the trees were 7 years old. As the chart shows, the 17 cases of yellows occur in this orchard of 1200 trees in one corner adjacent to a small area of low, rough, wet land. This spot is of

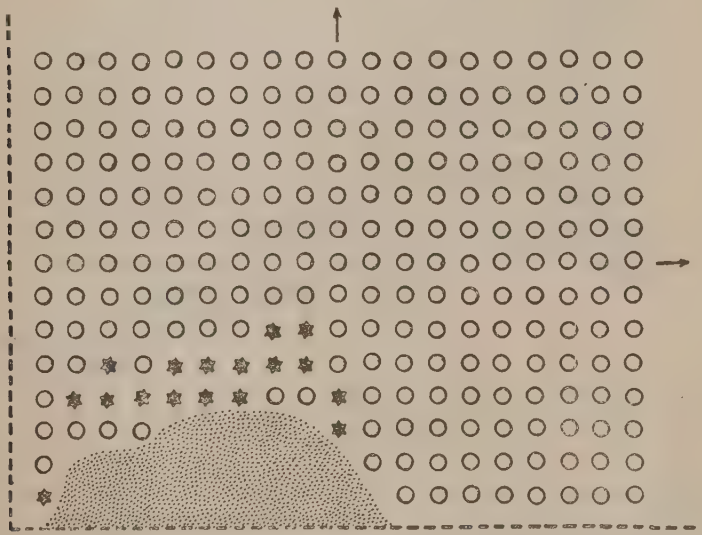

Fig. 9. Diagram showing portion of orchard of Herbert Allison in Cumberland County.

the sinkhole type since drainage water collects there in spring and remains for a considerable time. It could not be cultivated readily and has been permitted to grow into trees and shrubs with a mass of vines, grass and weeds around the border. The plant list for this area was made somewhat late in the season but it is probable that all but a few species were still present in some stage of growth. The list as in all other cases includes the plants in the orchard in the area affected by yellows, as well as those found in the waste land. There is good evidence that the yellows in these trees represents two years of infection.

Case 2

The orchard of William Bingham in Franklin County is another example of yellows grouping (See Fig. 10). The block of peach trees charted consists of about 1,000 trees interplanted among apples. The map of the yellows area was made in 1926 at which period the orchard was in its 8th year. In the small area mapped representing less than one-fifth of the whole block there have been taken out 23 yellows trees since the orchard was started. At least half of these cases developed previous to 1924 when the orchard was 5 years old or younger. The number of yellows found in the rest of the orchard

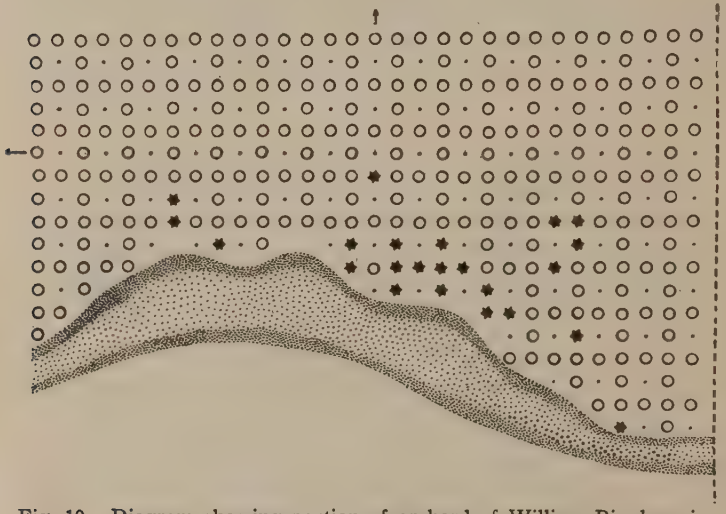

Fig. 10. Diagram showing portion of orchard of William Bingham in Franklin County.

during this whole period has been negligible, and since the owner has always been unusually vigilant and prompt with the ax it is quite evident that there exists at this spot some condition especially favorable to the disease. The map indicates at this edge of the orchard a rather broad and shallow ditch too rough for cultivation and filled with a tangle of natural vegetation. On the other side of this drainage channel a younger and smaller peach orchard exists. No yellows has appeared in it to date. A sparse wood used for pasturage adjoins the orchard beyond the fence on the right and both orchard and ditch continue on the left for a distance about equal to that on the chart.

The list of plants growing along the water course and in the orchard within the yellows area was made July 22, 1926.

Case 3

In one of the groups of orchards composing the Ontelaunee system in Berks County, F. L. Holdridge, chief inspector for the Department, noted a small cluster of yellows in one spot in the inspection of 1926. This orchard designated as "Ont. No. 10" is not extensive, containing only 363 trees and extending in roughly rectangular fashion along an unfenced road. The upper end only is shown (See Fig. 11). The 6 yellows trees found in this 4-year-old orchard in

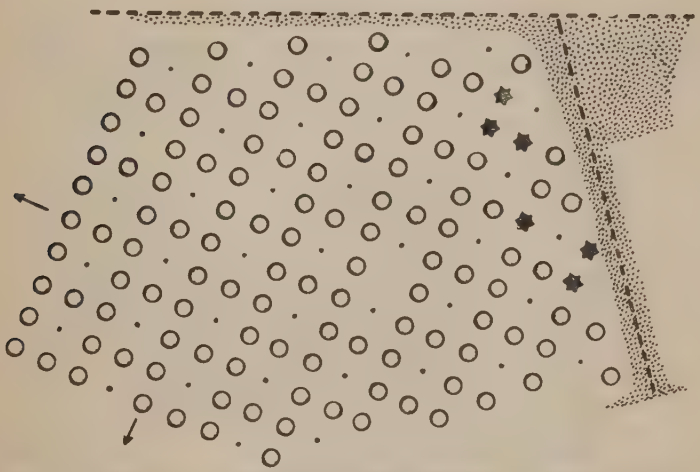

Fig. 11. Diagram showing part of the Ontelaunee orchard in Berks County. (Ont. No. 10.)

1926 when the chart was made were grouped at one end. The lower side abuts on the roadway with a narrow headland which has a few weeds but is mostly grass; the upper side is a fence with many well grown trees in the shade of which vegetation is scanty; at the end on the right the fence is open, wide and well supplied with the usual growth of native plants. Across this fence at the upper part is an old neglected garden now overgrown with grass, weeds and shrubbery. The plant list given for this spot takes in the fence row on the end, the orchard zone containing the diseased trees, and the neglected garden. No peaches grow above this orchard or to the right but there is another larger peach orchard of about the same age across the roadway.

Case 4

In making inspection in Franklin County in 1924 a young orchard of 1500 trees belonging to John Sierer was gone over for the first time. It was then four years old. The orchard sloped from the Lincoln Highway toward higher ground and was traversed diagonally by a small watercourse, dry most of the year but kept moist much of the time by surface drainage. Along its course at the lower end where it could not be crossed by cultivating implements it was well fringed with vegetation especially near the outlet at the road. As the chart (See Fig. 12) indicates 5 trees were marked

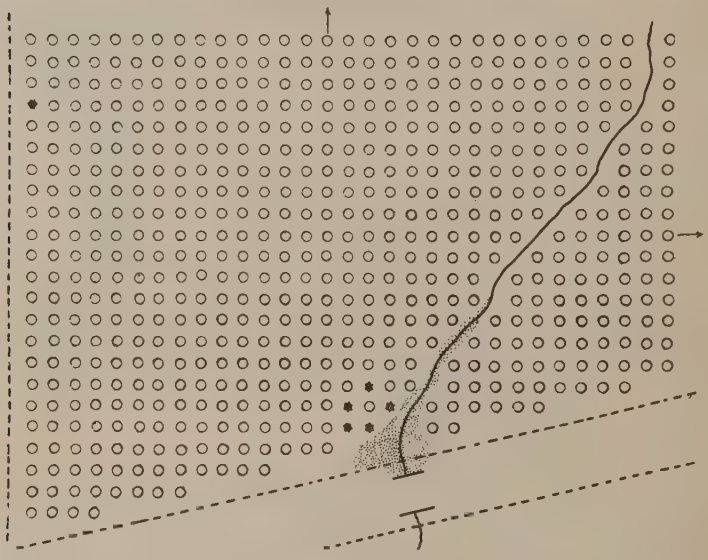

Fig. 12. Diagram showing corner of orchard of John Sierer in Franklin County.

for yellows in 1924 in one spot in the hollow adjacent to this ditch. One other yellows tree was found as indicated at the left in the outside row, and no other diseased trees could be elsewhere located. The map and list of plants along the watercourse were made in July, 1926.

All the trees in this case were in the same stage of disease when found and since the nest of five occurs in three rows either way, origin from nursery stock is almost precluded.

Case 5

The orchard of Daniel Feick near Reading in Berks County is a small block of 168 trees in 4 rows located at one side of a field used for truck and field crops. A fence bounds it on the two ends and one side. A row of irregular blackberry and raspberry plants extends from the left end between fence and trees practically the whole length of the orchard and both on this strip and along the fences there is abundant growth of weeds and wild plants. The field below the fence was planted to corn.

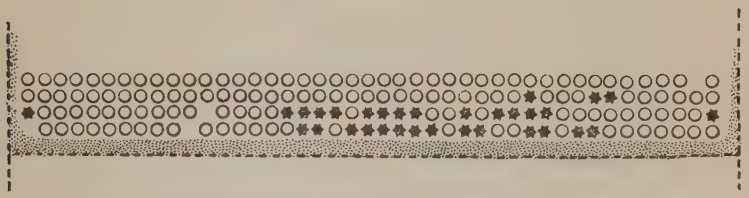

Fig. 13 Diagram showing the orchard of Daniel Feick, Berks County.

At the time the chart (Fig. 13) and plant list was made (Aug. 25, 1927) the orchard was 5 years old. The grouping of the yellows trees indicated in the chart had been noted and reported earlier in the summer in the course of inspection by J. F. Rees. While the grouping here is not so marked as in other cases there is an evident concentration of the disease along the fence side and toward the center of the orchard, with an isolated case at each end. The missing trees probably died from borer injury.

Case 6

The orchard of F. B. Reed in Franklin County was planted in 1922 in a good location on high somewhat rolling land. It was set out with apples, peach trees being used for interplants. It contained approximately 5,000 peach trees and was first given inspection in 1924 by the writer, the orchard being then in its third year. At the date of inspection (Sept. 9, 1924) no disease was found in any part of the orchard except in one spot. Here there were marked 26 trees with well developed symptoms of yellows. The remarkable feature about this case is the manner in which the diseased trees were grouped in circular fashion about a small sinkhole. The sinkhole itself is of the typical sort met with in limestone regions, consisting of a rather abrupt depression which could not be cultivated and consequently was allowed to grow up with natural vegetation. In the center vegetation was sparse because the spot had been used as a dump ground for stones and other waste matter. It is worthy of note that prunings from another peach orchard are reported to have been deposited here in previous seasons. The map and list

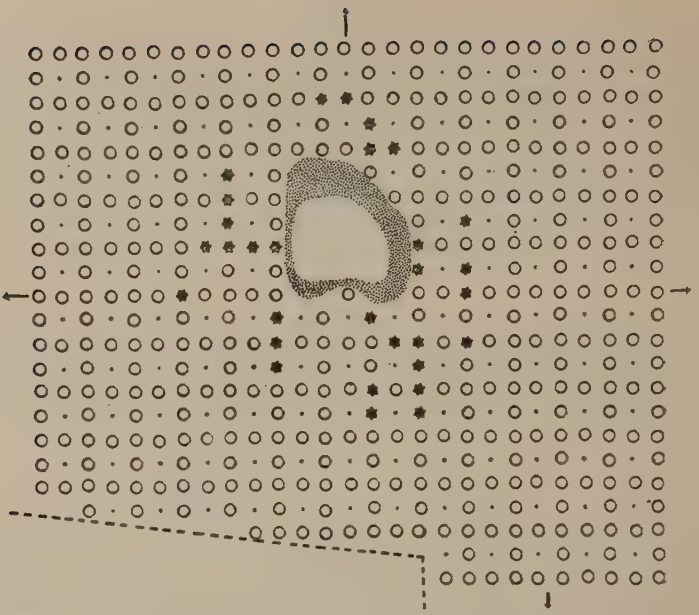

Fig. 14. Diagram showing orchard of F. R. Reed in Franklin County.

of plants growing in and around this sinkhole was made in July, 1926. Although the 26 trees first found were quickly removed as well as those which cropped up later, their location was easily established by stumps or replants or vacant places when replants had died. The chart (Fig. 14) shows 30 trees with yellows in the vicinity of this sinkhole, all within a distance of about 100 feet from its border. The four additional cases had developed in the intervening year. In 1926 the group still retained its distinctive and isolated character but yellows groups had appeared in several other places in the orchard.

Either the removal of the originally diseased trees had stopped much further spread or favorable infection conditions had not again been present in this particular spot.

In any event this case is outstanding. When such a number of diseased trees occur in a young orchard otherwise free from yellows, and are grouped in almost circular fashion aroung a well marked center, it is evident at once that the sinkhole bears some intimate relation to the disease.

Other Cases

In addition to the six examples given there are many other cases where the evidence has not been methodically arranged but which illustrate in some degree the situation existing in the six cases given as examples.

A rectangular orchard of 1150 trees in Cumberland County north of Carlisle (Burgett) was noted in 1925 by inspector F. G. Wilson to have 14 yellows trees in a group in a low corner adjacent to a stream. The rough ground along the stream and intervening fence row was of course covered with native plants. Outside this small corner no yellows was found in the orchard which at that time consisted of 650 trees 11 years old and 500 4-year-old trees. The yellows area was in the older section. Since that time no yellows has been found to date (1927) outside this corner except a tree in 1925 and another in 1927, both found on the outer row at the farther end of the orchard.

The Orchard of Howard Anderson in York County has had a similar area of yellows developed at one edge adjacent to the farm buildings. It was 8 years old at the time of observation in 1926 but there was evidence of some secondary infection so that the original condition was no longer clear.

In the Ontelaunee group of orchards in Berks County a block of trees additional to the one mapped is worthy of mention. In this case there has been for several years an unusual development of yellows in one corner where the land is low and adjoins a flat waste valley overgrown with wild vegetation and threaded by a small stream. The rest of the orchard during this period has been little affected by yellows and the persistence of the disease in this one spot is the more significant on account of the promptness with which the owners remove all affected trees.

In the orchard of Charles Sayer near Pricetown in Berks County, an unusual development of yellows took place in 1925 in a two year old orchard. This case is being given special study by Dr. Albert Hartzell of the Boyce-Thompson Institute.

Another case of localized development of yellows was observed in the Boyertown orchards in Berks County. The yellows grouping occurred at one end with little development of disease elsewhere. Owing to the fact that an apple orchard adjacent to the yellows spot had been started with peach interplants some of which might have persisted until after the new peach orchard was set out, any evidence from this place has doubtful value.

In 1926 an outbreak of yellows was found in the Vogel orchard in Lancaster County adjacent to a wood on one end and an old black raspberry plantation on the side. Outside this area the disease was absent. The orchard was at this time 5 years old.

We are indebted to C. M. Rhodes connected with the Ontelaunee orchard system at Leesport in Berks County for additional evidence that may have some significance. In removing yellows trees in the various orchards of the group he was struck by the very frequent occurrence of the disease in the outer rows of the peach blocks. He then kept record of the location of all trees removed during the season (1926) and found that out of 101 trees removed for yellows 95 were taken from the outer ten rows and only 6 from the trees in the interior. He has further furnished a table covering three of these orchards on which are indicated the relative numbers of trees in the outer ten rows and in the interior, and the number of yellows trees found in each category (Table 5). The orchards are all somewhat irregular in shape and on account of this feature he made his estimation from orchard maps.

Table 5. Occurrence of Yellows in Outer Rows in Ontelaunee Orchards

Orchard No.	No. of Trees			No. of Yellows		
	Total trees in orchard	Trees in outer 10 rows	Trees in center	Total Yellows	Yellows in outer 10 rows	Yellows in center
1	3,609	979	2,630	23	23	0
3	1,540	645	895	24	24	0
5	2,106	1,184	922	20	16	4
Totals	7,255	2,808	4,447	67	63	4

In these orchards the number of diseased trees in the outer ten rows is just about 25 times the proportion found in interior trees. Even allowing a generous margin for accidental variation the discrepancy is still so outstanding that one is inclined at once to look for some connection between the disease in the orchard fringe and the native wild plants abundantly scattered along the bordering fence rows and waste land.

Table 6. Table Listing Other Plants Growing Adjacent to Groups of Peach Trees Affected by Yellows

	1	2	3	4	5	6	7	8	9
	Allison	Bingham	Ontelaunee 10	Sierer	Feick	Reed	Ontelaunee 3	Burgett	Boyertown Fruit Co.
1. Abutilon theophrasti	X		X						
2. Acalypha virginica			X		X		X		X
3. Acer rubrum	X								
4. Achillea millefolium	X	X	X			X			X
5. Actinomeris alternifolia		X							
6. Agastache nepetoides		X							
7. Agropyron repens					X				
8. Agrostis alba				X	X	X			
9. Allium vineale	X						X	X	
10. Alnus rugosa								X	
11. Amaranthus graecizans					X			X	
12. Amaranthus hybridus	X		X		X		X		
13. Amaranthus retroflexus		X		X		X			X
14. Ambrosia artemisiifolia	X	X	X	X	X	X	X	X	X
15. Ambrosia trifida		X	X	X					
16. Anthemis cotula	X	X		X		X			
17. Apocynum androsaemifolium		X			X	X			
18. Arctium minus	X	X	X	X	X	X	X		X
19. Asclepias incarnata			X		X		X		
20. Asclepias syriaca	X	X	X	X	X	X	X	X	X
21. Asparagus officinalis					X				
22. Aster cordifolius	X								X
23. Aster divaricatus		X							
24. Aster ericoides		X	X	X			X	X	
25. Aster lateriflorus		X							

	1 Allison	2 Bingham	3 Outelaunee 10	4 Sierer	5 Feick	6 Reed	7 Outelaunee 3	8 Burgett	9 Boyertown Fruit Co.
26. Aster paniculatus		X			X				
27. Aster puniceus							X		
28. Aster salicifolius				X					
29. Barbarea vulgaris	X	X	X	X			X		X
30. Bidens bipinnata					X			X	X
31. Bidens cernua					X				
32. Bidens frondosa		X				X	X		
33. Bidens vulgata			X	X			X		
34. Brassica oleracea			X				X		
35. Bromus commutatus				X					
36. Campanula aparinoides									X
37. Capsella bursa-pastoris					X				
38. Castanea dentata	X								
39. Carya sp.	X	X				X	X	X	
40. Celtis occidentalis	X	X							
41. Cerastium vulgatum					X				
42. Cercis canadensis		X							
43. Chelone glabra							X		
44. Chenopodium album	X	X	X	X	X	X	X	X	X
45. Chenopodium boscianum			X						
46. Chrysanthemum leucanthemum								X	
47. Cichorium intybus			X		X		X	X	X
48. Cimicifuga racemosa	X								
49. Circea lutetiana		X							
50. Cirsium arvense			X				X		
51. Clinopodium vulgaris							X		
52. Commelina sp.						X			
53. Convolvulus sepium		X							
54. Corylus americana									X
55. Cucumus sativus					X				
56. Cuphea petiolata	X	X					X	X	X
57. Cyperus strigosus							X		X
58. Dactylis glomerata	X	X	X	X			X	X	X
59. Datura stramonium			X						
60. Daucus carota	X	X	X	X	X	X	X	X	X
61. Digitaria sanguinalis	X		X				X	X	X
62. Echium vulgare				X					
63. Elymus riparius				X					
64. Epilobium coloratum							X		
65. Erigeron annuus	X				X	X		X	
66. Erigeron canadensis	X	X	X		X		X	X	X
67. Erigeron ramosus			X	X			X		X
68. Eupatorium ageratoides	X								
69. Eupatorium perfoliatum		X					X		
70. Euphorbia maculata	X		X		X		X	X	X
71. Festuca elatior				X					
72. Fragaria americana									X
73. Fragaria virginiana	X						X	X	
74. Fraxinus americana									X
75. Galium aparine		X							
76. Galium trifiorum									X
77. Geum strictum							X		
78. Geum virginianum		X							
79. Hedeoma pulegioides	X	X						X	
80. Helianthus tuberosus			X						
81. Hypericum sp.								X	
82. Impatiens fulva				X			X	X	
83. Ipomoea pandurata	X				X	X			
84. Juglans nigra			X						
85. Lactuca sp.		X		X				X	
86. Lactuca hirsuta			X		X		X		X
87. Lactuca scariola		X		X	X	X		X	
88. Lactuca spicata							X	X	
89. Lappula virginiana		X							
90. Leonurus cardiaca		X	X	X					
91. Lepidium campestre	X	X					X	X	
92. Lepidium virginicum					X	X			
93. Linaria vulgaris	X	X		X	X		X	X	X
94. Lobelia inflata					X				X
95. Lobelia siphilitica							X		
96. Lychnis alba			X				X		
97. Lycopus sp.				X			X		

	1 Allison	2 Bingham	3 Outelaunee 10	4 Sierer	5 Feick	6 Reed	7 Outelaunee 3	8 Burgett	9 Boyertown Fruit Co.
98. Lysimachia quadrifolia	X								
99. Malva rotundifolia				X	X	X	X		X
100. Malva moschata								X	
101. Medicago sativa			X				X	X	
102. Melilotus officinalis					X				
103. Mentha piperita				X					
104. Mentha spicata							X		
105. Muhlenbergia sp.			X		X	X			X
106. Nepeta cataria	X	X	X	X	X	X	X		X
107. Nepeta hederacea			X						
108. Oenothera biennis		X	X	X	X		X	X	X
109. Osmorrhiza longistylis	X								
110. Oxalis acetosella		X		X	X	X			
111. Oxalis corniculata	X		X				X	X	X
112. Panicum sp.	X								
113. Panicum capillare	X		X				X		X
114. Papaver rhoeas				X					
115. Parietaria pennsylvanica		X							
116. Phalaris arundinaceae							X		
117. Phaseolus vulgaris					X				
118. Phleum pratense		X		X		X		X	X
119. Physalis heterophylla	X		X		X		X	X	X
120. Physalis virginiana		X							
121. Physalis viscosa		X							X
122. Phytolacca decandra	X	X	X	X	X	X	X	X	X
123. Pilea pumila		X	X				X		
124. Plantago lanceolata	X	X	X			X	X	X	
125. Plantago major	X	X	X		X	X	X	X	X
126. Poa annua						X			
127. Poa compressa					X	X			
128. Polygonum aviculare							X		
129. Polygonum convolvulus						X			
130. Polygonum erectum							X		
131. Polygonum hydropiper	X				X		X		
132. Polygonum hydropiperoides			X				X		X
133. Polygonum pennsylvanicum	X	X	X			X	X		X
134. Polygonum sagittatum							X		
135. Polygonum scandens		X		X	X				X
136. Polygonum virginianum									X
137. Portulacca oleracea		X				X	X		X
138. Potentilla canadensis	X								
139. Potentilla monspeliensis	X	X	X			X	X	X	X
140. Prunella vulgaris	X						X		X
141. Prunus avium						X			X
142. Prunus persica						X			
143. Prunus serotina			X						X
144. Prunus virginiana	X	X						X	
145. Psedera quinquefolia	X	X	X	X		X		X	X
146. Quercus sp.	X					X			
147. Quercus alba	X					X			
148. Ranunculus abortivus	X							X	
149. Rhus alata								X	
150. Rhus copallina	X								
151. Rhus glabra		X		X					
152. Rhus toxicodendron		X	X	X	X		X		X
153. Robina pseudo-acacia	X	X				X			
154. Rosa carolina						X			
155. Rubus sp.	X				X		X		X
156. Rubus alleghaniensis		X	X	X		X			
157. Rubus hispidus	X			X				X	
158. Rubus neglectus					X				
159. Rubus occidentalis	X	X	X	X	X	X	X		X
160. Rubus villosus				X		X			
161. Rumex acetosella	X			X		X	X	X	
162. Rumex crispus			X	X	X	X	X		X
163. Rumex obtusifolius			X						X
164. Sambucus canadensis	X	X				X	X		X
165. Saponaria officinalis				X					
166. Sassafras sassafras	X					X			X
167. Satureja vulgaris		X							
168. Scirpus cyperinus							X		
169. Secale cereale	X								

	1	2	3		5	6	7	8	9
	Allison	Bingham	Outelaunee 10	Sierer	Fitch	Reed	Outelaunee 3	Burgett	Boyertown Fruit Co.
170. Setaria glauca			X				X	X	X
171. Setaria verticillata									X
172. Setaria viridis	X			X	X	X			
173. Sida spinosa					X			X	
174. Silene antirrhina		X		X	X				
175. Silene latifolia							X		
176. Silene noctiflora					X				
177. Sisymbrium officinale		X				X			
178. Smilacina racemosa									X
179. Smilax rotundifolia	X								X
180. Solanum nigrum	X						X		
181. Solidago altissima	X			X		X	X	X	
182. Solidago graminifolia	X	X		X			X	X	
183. Solidago juncea		X							
184. Solidago rugosa									X
185. Solidago sp.	X								
186. Specularia perfoliata						X			
187. Steironema ciliatum							X		
188. Stellaria media	X		X				X		
189. Taraxacum officinale			X		X		X	X	X
190. Trifolium agrarium	X						X		X
191. Trifolium arvense									X
192. Trifolium hybridum					X				
193. Trifolium pratense					X			X	X
194. Trifolium repens			X		X		X		
195. Verbascum blattaria	X				X				
196. Verbascum thapsus		X		X					
197. Verbena hastata		X		X		X			
198. Verbena officinalis			X				X		
199. Viola papilionacea							X		
200. Viola triloba		X							
201. Vitis cordifolia	X		X				X	X	
202. Vitis vulpina	X	X		X					X
203. Xanthium sp.	X	X	X	X					
204. Zea mays	X				X				

Significance of Yellows Groups

When the incidence of yellows is observed time after time in groupings having a close relation to wild vegetation there arises a suspicion that this disease may not be entirely confined to the peach, but may also occur on some other host or hosts. With such suspicion there goes naturally the idea of insect transmission as the necessary complement to any hypothesis that would fit the cases under consideration as well as those involving circular spread mentioned at the outset.

As to the role played by the natural vegetation in such a case there are apparently three possibilities: (1) wild plants might be alternate hosts of a possible transmitting insect and because its hosts are close together and abundant the insect is plentiful in this particular locality; (2) the cover furnished by masses of undisturbed natural vegetation may provide suitable winter quarters for the insect and thus ensure its local abundance; (3) one or more wild or cultivated plants may carry the virus and it may be transmissible

from them to peach trees in close proximity through the agency of insects.

It may be noted that while the first and second possibilities might provide sufficient explanation of the localized spread from peach to peach noted for the general orchard as well as for these particular cases, these possibilities take no account of the original source of infection. The third possibility permits the construction of a hypothesis satisfactorily including this important point. It is apparent further that the possibilties mentioned are not mutually exclusive; a hypothesis might require a combination of any two of them or even of all three.

The lists of native and cultivated plants are given here in an effort to accumulate such information as might be useful in a general inquiry into insect transmission and the possibility of other host relationships. The lists contain all the plants that could be found when the survey was made but it must be understood that in certain cases orchard cultivation may have suppressed some species temporarily. Furthermore the list of plant inhabitants at the time of survey may not be exactly coincident with the species growing there two or three years previously.

These lists of plants associated with such suspicious cases of yellows might be expected to include an alternate host or hosts if there is such. Moreover one would hope to be able to limit the search by comparing these lists and noting what species are common to all; if another plant has an alternate host relationship it is likely to be constantly present in such peculiar circumstances as here obtain. Such constant association might not hold if two or three species were equally good alternate hosts, but lacking any helping hints in this direction one can at least begin by sorting out all the individual species persistent throughout the series. The plants found in all six cases are: **Ambrosia artemisiifolia, Actium minus, Chenopodium album, Daucus carota, Nepeta cataria, Phytolacca decandra,** and **Rubus occidentalis.** Two other species, **Plantago major** and **Psedera quinquefolia,** are common to five of the six cases. All others occurred in only four cases or fewer.

It will be noted that in addition to the lists of plants associated with the six cases charted there are also included similar lists for three other localities. While these orchards have not been charted, two of them at least, Outelaunee No. 3 and the Burgett orchard, are as outstanding cases as those presented in chart form. In the Boyertown orchard the evidence is not so valuable but the list of local species is included in case it might have some value.

If the above analysis is revised so as to include all 9 lists it will be seen that 5 species are common throughout: **Ambrosia artemisiifolia, Asclepias syriaca, Chenopodium album, Daucus carota,** and **Phytolacca decandra.** It must be admitted at the outset that every one of these species is extremely common in the districts in question and the occurrence of any one of them throughout the series may be attributed entirely to its universal abundance; but in spite of this weakness, and even confessing that these observations direct us to no wild plant as a host for peach yellows, and indicate no insect as a carrier, yet the evidence provided by the cases quoted constitute very strong ground for belief in the existence of an alternate host and insect transmission.

Diagnosis of Yellows Through Premature Blossoming*

There has long been noted a tendency in peach trees suffering from yellows to come into bloom a few days earlier than their healthy fellows. This premature blossoming is even outstanding at times on trees which have symptoms on only one limb. Such a branch is often conspicuously quicker to open its flowers than the rest of the tree. If this early blooming propensity could be taken as a reliable indication of the presence of yellows it might be of advantage to utilize it in a program of spring inspection thus permitting the eradication of diseased trees so much the sooner.

Before attempting to use this feature for inspection purposes a test was made to determine to what extent a blossom period diagnosis was reliable. Three large orchards were visited at the blooming period and all trees showing branches with forced bud development or abnormally early flowers were tagged. In July a second visit was made for the usual inspection and all yellows was recorded.

The results of the two series of observations were put into three categories: (1) tagged trees later showing yellows; (2) tagged trees showing no yellows in midsummer; and (3) yellows on trees which had not been tagged. If all the yellows found in summer inspection fell into the first category, it would indicate that the early spring method was reliable. But unfortunately such a considerable proportion of the yellows trees marked in summer inspection fell into the second and third groups that any thought of using early blooming for yellows inspection purposes had to be abandoned. While the disease undoubtedly hastens blossoming this feature is not certain enough for practical inspection.

Do Nurseries Spread Peach Yellows?

Peach growers everywhere have from time to time blamed nurserymen for sending out peach yellows in nursery stock; and from what little was known about the disease there seemed to be some justification for this charge. It is established that the disease can be transmitted by budding, at least into larger trees, and the habit in nurseries of budding large blocks from other nursery stock appeared to provide ample opportunity for disease spread by this method. An attempt was made in 1925 to gather evidence bearing on this point. The inspection records of the Department give complete data on the age and number of yellows for each block of trees in the orchards covered, and to supplement these records the nursery origin of 158 orchards containing 157,796 trees was ascertained by questionnaire. These records of origin were then united with the inspection data in such a way as to list under each nursery the orchards derived from it together with the yellows found in each. It should be noted that only younger orchards were included in this summary to minimize the complications arising from possible secondary spread. If any individual nursery were guilty of spreading yellows in its stock the lists thus compiled would show it at once in the excessive amount of disease in the young orchards planted from its stock. There were no such nurseries. Analysis of the data from any angle failed to cast the slightest suspicion on any nursery either in or out of the state. The result must be taken to mean that our peach nursery stock is at least of minor importance as a means of spreading yellows.

*McCubbin, W. A. and Holdridge, F. L., Observations on Peach Yellows; Proc. Penna. Academy of Science, Vol. 1; 1927.

PENNSYLVANIA DEPARTMENT OF AGRICULTURE

Organization and Services

C. G. JORDAN, *Secretary of Agriculture* R. G. BRESSLER, *Deputy Secretary*

This Department is essentially a service agency created by legislative enactment to deal with administrative, regulatory, investigational, and educational problems which can best be solved through public rather than individual action. The organization provides for coordination and cooperation with the Pennsylvania State College and the U. S. Department of Agriculture. The Department operates through the following bureaus:

ANIMAL INDUSTRY: T. E. MUNCE, *Director and State Veterinarian*

Prevents and Eradicates transmissible diseases of animals and poultry, including tuberculosis of animals in cooperation with Federal Government;

Demonstrates to veterinarians control methods for transmissible animal diseases;

Supervises vaccination for and the prevention of hog cholera, anthrax, black leg and hemorrhagic septicemia;

Protects public from unwholesome meats through ante and post mortem examinations of animals at slaughtering establishments;

Inspects, licenses and furnishes information as to breeding, soundness and conformation of stallions and jacks standing for public service;

Enforces law requiring licensing of dogs and providing for protection of livestock and people from attacks of uncontrolled dogs;

Maintains laboratory for diagnostic research and experimental projects

PLANT INDUSTRY: R. H. BELL, *Director*

Tests agricultural seeds for purity and germination, and enforces State Seed Law;

Inspects orchards, parks, farms, and plant imports for injurious insects and plant diseases;

Inspects and licenses Pennsylvania nurseries, and licenses all dealers in nursery stock;

Enforces laws governing apicultural practices, disease control and housing;

Places and enforces quarantines and carries on eradication campaigns against insect pests and plant diseases;

Inspects and certifies potatoes for seed purposes;

Makes investigations for the control of injurious insects and plant diseases including field tests of insecticides, fungicides and weed killers;

Maintains collections of insects, plant diseases, plants, and seeds, and identifies specimens.

FOODS AND CHEMISTRY: JAMES W. KELLOGG, *Director—Chief Chemist*

Accomplishes its purpose of protecting Pennsylvania homes against harmful foodstuffs by sampling, analyzing, and bringing prosecution under the laws relating to foods and non-alcoholic drinks, including milk, cream, butter, ice-cream, eggs, sausage, fresh meats, soft drinks, fruit syrups, vinegar and kindred food products;

Regulates and issues licenses for the manufacture and sale of oleomargarine;

Licenses and regulates egg-opening plants and cold storage warehouses, maintaining regular inspection and enforcing twelve-month storage limit;

Inspects milk plants and creameries and regulates weighing, testing, buying and selling of milk and cream on a butterfat basis;

Protects honest manufacturers, importers, selling agents and ultimate users of feeding stuffs, fertilizers, lime products, linseed oil, paint, putty, turpentine, insecticides and fungicides, by means of annual registrations followed by inspections, analyses, prosecutions and the publication of the analyses of these products;

Analyzes special samples for residents of the State at the rate of $1.00 a sample for feeding stuffs, lime products and linseed oils.

MARKETS: GEO. A. STUART, *Acting Director*

Investigates and assists in the marketing of farm products; at present chiefly grain and hay, fruits and vegetables, poultry and eggs, and tobacco;

Compiles and distributes daily market information as to supplies, shipments and prices;

Advises growers on transportation of agricultural products;

Assists cooperative associations and public markets;

Establishes standard grades of farm products and maintains inspection.

STATISTICS: L. H. WIBLE, *Director*

Assembles and disseminates essential statistics and facts pertaining to the agriculture of the State, from monthly reports rendered by hundreds of volunteer crop correspondents, information which assists the producer in his sales and interests all industries which deal with agricultural products;

Cooperates with U. S. Bureau of Agricultural Economics in joint crop and livestock reporting and publishes annual and monthly summaries of the data;

Compiles dates of county and local fairs and assembles data pertaining to their success and results during each year.